Ultrasonic Phased Array Non-Destructive Testing and In-Service Inspection System for high integrity Polyethylene Pipe Welds with automated analysis software
INTRODUCTION

Traditional way to ensure the quality of BF and EF welded joints in PE pipes during installation

Control welding parameters + Visual inspection + Hydrostatic pressure test

Destructive test on representative welded joints.

The integrity of the pipeline can’t be ensured.
INTRODUCTION

PolyTest → NDT inspection system Phased Array Ultrasonic Testing

The objective is to take recently developed FP7 inspection/NDT technology for polyethylene pipe welds, from TRL6 to a TRL9 commercial product that will be exploited globally by the consortium partner providers to the consortium end user.

MEMBERS OF THE CONSORTIUM

The research leading to these results has received funding from the European Union's Seventh Framework Programme under grant agreement number: 701194
MAIN FEATURES

The equipment has been designed and optimised to provide:

• Phased Array ultrasonic probes, operating at the optimal frequencies
• A simple and flexible scanner to accommodate pipes with outside diameters from 90-900mm, with a maximum wall thickness of 72mm.
• Membrane water wedges ensures scan surface conformability across diameter and weld type range.

The system enables detection of all types of flaw that can occur in PE pipe welds including planar flaws, particulate contamination and cold welds.
The PAUT inspection system consists of:

- a phased array probe
- a probe wedge
- a probe holder
- a scanner
- a flaw detector

The design of each of these components has been optimized specifically for inspecting PE pipes.
REQUIREMENTS. The PolyTest™ Scanner

Supplied with a chain link scanning mechanism containing a probe carriage with positional encoding, holding a phased array UT probe housed in a water filled membrane wedge.

- Capable of operating reliably under normal site conditions in different sectors
- IP67 Rated
- Easily attached/removed by one operator
- Capable of producing encoded phased array UT data on any commercially available (32:128 or better) PAUT equipment
- All parts capable of replacement without the need of specialist tools and under normal site or workshop conditions
Butt fusion (BF) and electrofusion (EF) welded samples are required for the project with the following criteria:

- To determine the probability of detection (POD) of planar lack of fusion flaws;
- To validate the automatic defect recognition (ADR) procedures;
- To validate defect sizing capabilities of the system;
- For the training course and examination for the inspection personnel.
SOFTWARE INTEGRATION

M2M have developed a bespoke software package for installation on the Gekko array controller.

The main objectives are to:
1. Develop ADR algorithms for EF and BF joints
2. Integrate these algorithms into the Gekko Platform Development Kit (PDK) software
3. Validate both EF and BF algorithms on multiple data sets.

Before arriving at final versions for the EF and BF ADR algorithms, these algorithms need to be extensively tested on pipes with different diameters and wall thicknesses.
CHAIN LINK SYSTEM

- The scanner length shall be easily adjusted without the need for tools, to accommodate a range of pipe diameters.
- The scanner shall provide a means of moving it around the pipe without discomfort or undue effort from the operator.
- The chain tension shall be adjustable to ensure scanner tracks around the pipe without axial drift.
- The scanner should provide a means of maintaining a constant chain tension to accommodate pipe ovality and repeated fitting across a range of pipe diameters.
**PROBE CARRIAGE**

- The probe shall be capable of easy adjustment in the pipe axial length
- The probe shall be held onto the scan surface in all orientations
- The probe mounts shall provide a quick means to replace the probe wedge body
- The carriage shall maintain its force on the scan surface in all orientations
- The carriage shall permit vertical movement of the wedge
- Shall maintain the probe alignment to the pipe axis throughout the scan
PHASED ARRAY PROBES

**Butt fusion probe**
The new probe design simplifies the probe package $\rightarrow$ 4.0MHz and 2.25MHz, both frequency array options in the same probe package.

**Electrofusion probe**
128 elements to generate a focused beam along the length of the array. Two frequencies; 3.5MHz and 5.0MHz, $\rightarrow$ a single wedge and simplified fitting for all EF fitting sizes.
Membrane Wedges

a single wedge capable of accommodating both high and low frequency probes for each weld type and thus wedge type
The following objectives of the proposed work were identified:

- Present the PolyTest system capabilities on welds in PE pipes.
- Demonstrate the PolyTest system to the client on-site.
- Installation projects, or existing pipe infrastructures.
- Perform data analysis and report any potential flaws.
POLYTEST SYSTEM DEMONSTRATIONS
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PolyTest system on EF weld sample produced on site

Scan on grooved scan surface – flaw indications indicated

Scan on grooved scan surface – no flaw indications
CONCLUSIONS

- The PolyTest PAUT System is a versatile site deployable inspection tool for EF welds in PE piping, covering a wide range of diameters and positions.
- The typical pipe infrastructure for Gas Natural consisted of diameters 100 mm and below, then there may be a need to scale down the system.

The PolyTest project consortium brings together all the necessary expertise to develop the already successful PolyTest system and realise its true potential as an invaluable inspection tool for all industries using PE/plastic piping.

PolyTest System demonstrations will be available on the TWI stand.
THANKS FOR YOUR ATTENTION

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